

The Invention

The present invention is directed to a susceptor that reduces damaging contact of a wafer and the susceptor. In accordance with one embodiment, the susceptor contacts the back side of the wafer along the peripheral edge thereof (approximating line contact with the wafer), with the remainder of the susceptor recessed beneath the wafer. The approximate line contact effectively seals the back side of the wafer, thereby reducing or eliminating undesirable back-side contact, undesirable back-side deposition. The susceptor is made from a material having a thermal expansion coefficient of about 2.6×10^{-6} to $5 \times 10^{-6}/^{\circ}\text{C}$, in order to approximately match that of the wafer. Approximately matching the thermal expansion coefficients of the wafer and susceptor maintains the approximate line contact, thereby further minimizing back-side damage and back-side deposition.

Rejections Under 35 U.S.C. § 102

Claims 1, 2, and 7-9 stand rejected under 35 U.S.C. § 102(e) as being anticipated by MacLeish *et al.* Claim 7 has been cancelled without prejudice or disclaimer, thereby rendering the rejection of this claim moot. Applicant's respectfully submit that the claimed invention is patentable over MacLeish.

An anticipation rejection requires that a single reference expressly or inherently disclose each and every element of a claim. *In re Paulsen*, 31 USPQ2d 1671, 1673 (Fed. Cir. 1994); MPEP § 2131 (citing *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)). Additionally, the reference must enable and describe the claimed invention "sufficiently to have placed it in possession of a person of ordinary skill in the field of the invention." 31 USPQ2d at 1673. To be enabling, the reference must teach the skilled artisan how to make and use the full scope of the claimed invention without undue experimentation. *See Genentech Inc. v. Novo Nordisk A/S*, 42 USPQ2d 1001, 1004 (Fed. Cir. 1997).

The Examiner argues, *inter alia*, that MacLeish *et al.* teach a susceptor made of silicon carbide. Applicants respectfully traverse.

MacLeish *et al.* teach that RF energy couples to silicon carbide coated graphite dish 32 to heat wafer 52 from above, and to graphite susceptor 50 to heat wafer 52 from below. *See, e.g.*, (col:ln) 5:59-63. In MacLeish, the susceptor is made from graphite to absorb RF radiation from the induction coils to heat the wafer. The MacLeish susceptor is not thermally expansion matched to the wafer and thus is subject to causing detrimental relative movement between the wafer and susceptor during heating and cooling, unlike the susceptor of the present invention.

Further, MacLeish states at column 5, lines 5 to 10 that “the top surface of susceptor 50 is recessed such that a minimum number of points along the outer edge of wafer 52 need be in intimate contact with susceptor 50 while wafer 52 rests thereon, thereby minimizing conductive heat transfer between susceptor 50 and wafer 52” (emphasis added).

Applicant respectfully submits that MacLeish teaches away from the present invention. MacLeish teaches one to minimize the number of points in contact with the wafer, unlike Applicant’s claims which recite support around the entire periphery edge. The susceptor in MacLeish would permit backside deposition. Moreover, MacLeish motivates one to minimize conductive heat transfer between the wafer and the substrate. The present invention seeks to maximize it. Applicant respectfully submits that the present invention is neither anticipated or obvious in light of MacLeish.

Rejections Under 35 U.S.C. § 103(a)

Claims 3-6, and 10-12 stand rejected under 35 U.S.C. § 103(a) as being obvious over MacLeish *et al.*; and Claims 3-12 stand rejected under 35 U.S.C. § 103(a) as being obvious over MacLeish *et al.* in view of Chen *et al.*

When rejecting claims under 35 U.S.C. § 103, the Examiner bears the burden of establishing a *prima facie* case of obviousness. *See, e.g., In re Bell*, 26 USPQ2d 1529 (Fed. Cir. 1993); M.P.E.P. § 2142. To establish a *prima facie* case, three basic criteria must be met: (1) the prior art must provide one of ordinary skill with a suggestion or motivation to modify or combine the teachings of the references relied upon by the Examiner to arrive at the claimed invention; (2) the prior art must provide one of ordinary skill with a reasonable expectation of success; and (3) the prior art, either alone or in combination, must teach or suggest each and every limitation of the rejected claims. The teaching or suggestion to make the claimed invention, as well as the reasonable expectation of success, must come from the prior art, not Applicant’s disclosure. *In re Vaeck*, 20 USPQ2d 1438 (Fed. Cir. 1991); M.P.E.P. § 706.02(j). If any one of these criteria is not met, *prima facie* obviousness is not established.

1. Claims 3-6 and 10-12 are not obvious over MacLeish et al.

As discussed above, MacLeish *et al.* teach a susceptor made from graphite, which does not have the thermal effect as recited by Claim 1. Graphite has anisotropic thermal properties which result in unpredictable thermal effects, particularly thermal expansion which is orientation dependent and difficult to control, and is thus not suitable for supporting a wafer around its entire periphery edge as recited in Applicant's claims. MacLeish *et al.* do not discuss the possibility of using a material different from graphite for the susceptor. As discussed above, MacLeish does not teach a susceptor which supports the wafer around its entire periphery edge and which maximizes conductive heat transfer. In fact as described above, MacLeish teaches away from Applicant's invention. Therefore, MacLeish *et al.* do not teach or suggest each and every element of Claim 1, and, for at least this reason, Claim 1 is not *prima facie* obvious over MacLeish *et al.* Claims 3-6, and 10-12 depend from Claim 1, and therefore contain each and every limitation of this claim. Therefore, for the reason Claim 1 is not *prima facie* obvious over MacLeish *et al.*, the Examiner has failed to establish a *prima facie* case of obviousness against Claims 3-6 and 10-12.

Moreover, the mere fact that a reference can be modified does not render the resultant modification obvious unless the prior art also suggested the desirability of the modification. *In re Mills*, 16 USPQ2d 1430 (Fed. Cir. 1990).

1. Claims 3-12 are not obvious over MacLeish et al. in view of Chen et al.

As discussed above MacLeish *et al.* fails to teach or suggest each and every element of the claimed invention. Moreover, there is no motivation to modify MacLeish *et al.* to arrive at the claimed invention.

Chen *et al.* do not make up for the deficiencies of MacLeish *et al.* Chen *et al.* Chen is directed at a graphite susceptor which as a coating that closely matches the thermal coefficient of the graphite in order to prevent cracking of the coating. Chen does not teach or suggest matching the thermal coefficient of the susceptor and wafer.

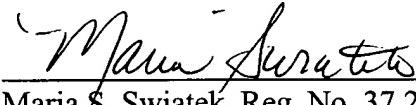
Moreover, Chen appears to contact the backside of the wafer. At col. 3, lines 37 to 57, Chen defines a substrate mounting surface 32 by the base edge 37 of beveled side 36 of lip 34. In one embodiment for a 200mm wafer, the edge 37 define a substrate mounting surface diameter of approximately 8". Rounded edges are used to reduce the stress on the wafer edge during thermal cycling. Thus, Chen does not support the wafer only around its entire periphery edge as recited in

Applicant's claims. Even if one were to combine MacLeish and Chen, one would not arrive at Applicant's invention.

CONCLUSION

Based on the foregoing, Applicant respectfully submits that the application is now in condition for allowance. If any matters can be resolved by telephone, the Examiner is invited to call the undersigned attorney at the telephone number listed below. The Commissioner is authorized to charge any additional fees to Deposit Account No. 06-1300 (Order No. A-64873-1/AJT/MSS)..

Respectfully submitted,



Maria S. Swiatek, Reg. No. 37,244

FLEHR HOHBACH TEST ALBRITTON & HERBERT LLP
4 Embarcadero Center, Suite 3400
San Francisco, CA 94111-4187
Telephone: (650) 494-8700

Appendix of Pending Claims

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1. A wafer carrier for supporting a substrate, comprising:
a circular plate having a flat edge region extending around the circumference of said plate; and
a circular recessed center region having a recessed bottom surface and including an upwardly inclined surface around the periphery of said recessed bottom surface,
wherein the substrate is supported by a portion of the upwardly inclined surface and is spaced apart from said recessed bottom surface such that the substrate is supported by said wafer carrier only around the entire periphery edge of the substrate, and wherein said substrate is comprised of a material having a coefficient of thermal expansion in the range of 2.6×10^{-6} to $5 \times 10^{-6}/^{\circ}\text{C}$.
2. The wafer carrier of Claim 1 wherein said recessed bottom surface further comprises at least one aperture formed therein for receiving at least one support member to engage the substrate.
3. The wafer carrier of Claim 1 wherein said circular recessed center region has a diameter of approximately 200 mm.
4. The wafer carrier of Claim 1 wherein said circular recessed center region has a diameter of approximately 300 mm.
5. The wafer carrier of Claim 1 wherein said upwardly inclined surface is inclined at an angle in the range of approximately 5 to 45 degrees to the plane of the recessed bottom surface.
6. The wafer carrier of Claim 1 wherein said upwardly inclined surface is inclined at an angle of approximately 10° to the plane of the bottom recessed surface.
8. The wafer carrier of Claim 1 wherein said wafer carrier is comprised of a material having thermal conductivity in the range of 40 to 70 W/m/K.

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9. The wafer carrier of Claim 1 wherein said wafer carrier is comprised of a material selected from the group of silicon carbide, aluminum nitride, large-grained polycrystalline silicon and silicon/silicon carbide alloy.

10. The wafer carrier of Claim 1 wherein the wafer is spaced apart from said recessed bottom surface by a distance of approximately 0.15 to 0.5 mm.

11. The wafer carrier of Claim 1 wherein the wafer is spaced apart from said recessed bottom surface by a distance of approximately 0.25 mm.

12. The wafer carrier of Claim 1 wherein said flat edge region has a width of approximately 5 to 25 mm.